APPENDIX A

CALCULATION OF ACTION LEVELS FOR ASBESTOS FIBERS IN AIR TASK-BASED MONITORING ACTIVITIES

1.0 Basic Equations

Risk from inhalation exposure to asbestos fibers may be calculated using two alternative risk models (IRIS, Berman and Crump 2003). In either case, the basic equation is

Risk = C * UR * TWF

Where:

C = Concentration of fibers in air (f/ml)
UR = Unit Risk (risk per f/ml)
TWF = time-weighting factor (fraction of lifetime during which exposure occurs)

The target action level can be calculated by revising the equation as follows:

AL = TR / (UR * TWF)

Where:

TR = Target cancer risk level

2.0 Calculation of Action Levels

Each of the three input parameters needed to calculate the target Action Level are discussed below, along with the resulting values.

Target Risk
Target Risk is a risk management judgment, and may depend on a number of factors. For the purposes of these calculations, the Target Risk was assumed to be 1E-04 (i.e., one in ten thousand).

Unit Risk
As noted above, there are two alternative methods for estimating cancer risk from asbestos, and hence there are 2 alternative values for UR:

IRIS (2003) identifies a unit risk of 0.23 per PCM fiber per ml

Berman and Crump (2003) identify a unit risk of 5.72? per TEM protocol structures per ml, assuming that 30% of the protocol structures are longer than 10 microns in length. This value is the average across males and females, smokers and non-smokers and also represents x percent chrysotile versus amphiboles??

Time-Weighting Factor
The TWF is the fraction of full time that exposure occurs. This depends on the assumed time, frequency, and duration of exposure. For the purposes of these calculations, the following assumptions were used:

Activity	Exposure Time (hr/day)	Exposure Frequency (d/year)	Exposure Duration (years)	Total hours	TWF
Total	24	365	70	613200	1.00
Residential	24	350	30	252000	0.41
Playing in the Dirt	2	270	10	5400	0.0088
Utility	4	9	1	36	0.00006
Gardening	10	50	30	15000	0.024

Commented [JW1]: Should we have a separate category for construction?

Note that these assumptions may not be identical to those that are used in the actual risk calculations. Rather, these were selected to represent a conservative estimate of the actual exposure associated with each scenario

Briefly, the values selected for these scenarios were based on the following references:

Residential: Region 10 Guidance for RCRA Cleanup Levels (EPA 1998)

Playing in the Dirt: Exposure Factors Handbook, Table 15-58, the 90th percentile value of 120 minutes/d for children ages 1-11 was used for the exposure time. Best professional judgment about snow cover at the site was used to arrive at 270 days/year and the entire span of the age group was used for exposure duration.

Utility: This scenario is described in Oregon DEQ's Guidance for Conduct of Deterministic Human Health Risk Assessments (May 2000 update).

Gardening: This scenario is based on the 95th percentile value for hours per month that adults garden as provided in the Exposure Factors Handbook, Table 15-62, combined with the standard EPA residential exposure duration.

Results

Based on these inputs, the target action levels are as follows:

Activity	Action Level	
	IRIS (PCM fibers/ml)	Berman and Crump (protocol fibers/ml)
Residential	0.001	0.00004
Playing in the Dirt	0.05	0.002
Utility	7.2	0.3
Gardening	0.02	0.0007

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Berman and Crump to be provided when correct UR is figured (chrysotile, what percent long?) – for the above, I assumed a Berman and Crump unit risk of 5.72 based on the same assumption as Libby. We could use site-specific data about the proportion of long fibers to come up with a better estimate.